IN-37

EE23BTECH11063 - Vemula Siddhartha

Question:
The signal flow graph of a system is shown. The expression for $\frac{Y(s)}{X(s)}$ is

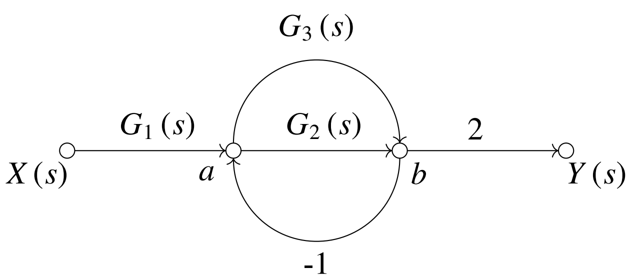

Fig. 0. Signal Flow Graph of the System

(a) $\dfrac{2G_1(s)G_2(s) + 2G_1(s)G_3(s)}{1 + G_2(s) + G_3(s)}$

(b) $2 + G_1(s) + G_3(s) + \dfrac{G_2(s)}{1 + G_2(s)}$

(c) $G_1(s) + G_3(s) - \dfrac{G_2(s)}{2 + G_2(s)}$

(d) $\dfrac{2G_1(s)G_2(s) + 2G_1(s)G_3(s) - G_1(s)}{1 + G_2(s) + G_3(s)}$

Solution:

Parameter	Description	Value
$Y(s)$	Output node variable	
$X(s)$	Input node variable	
$\frac{Y(s)}{R(s)}$	Transfer function	?
P_1	Forward Path Gain a-b through $G_2(s)$	$2G_1(s)G_2(s)$
P_2	Forward Path Gain a-b through $G_3(s)$	$2G_1(s)G_3(s)$
Δ_1	Determinant of Forward Path a-b through $G_2(s)$	1
Δ_2	Determinant of Forward Path a-b through $G_3(s)$	1
L_1	Gain of Loop a-b through $G_2(s)$ and back	$-G_2(s)$
L_2	Gain of Loop a-b through $G_3(s)$ and back	$-G_3(s)$
Δ	Determinant of System	$1 + G_2(s) + G_3(s)$
n	Number of forward paths	2

TABLE 4
VARIABLES USED

$$P_1 = (G_1(s))(G_2(s))(2) = 2G_1(s)G_2(s) \tag{1}$$

$$P_2 = (G_1(s))(G_3(s))(2) = 2G_1(s)G_3(s) \tag{2}$$

$$\Delta_1 = 1 - (0) = 1 \tag{3}$$

$$\Delta_2 = 1 - (0) = 1 \tag{4}$$

$$L_1 = -G_2(s) \tag{5}$$

$$L_2 = -G_3(s) \tag{6}$$

$$\Delta = 1 - (L_1 + L_2) = 1 + G_1(s) + G_2(s) \tag{7}$$

From 0, Using Mason's Gain Formula,

$$\frac{Y(s)}{X(s)} = \frac{\sum_{i=1}^{n} P_i \Delta_i}{\Delta} \tag{8}$$

$$= \frac{P_1\Delta_1 + P_2\Delta_2}{\Delta} \tag{9}$$

$$= \frac{2G_1(s)G_2(s)(1) + 2G_1(s)G_3(s)(1)}{1 + G_2(s) + G_3(s)} \tag{10}$$

$$\implies \frac{Y(s)}{X(s)} = \frac{2G_1(s)G_2(s) + 2G_1(s)G_3(s)}{1 + G_2(s) + G_3(s)} \tag{11}$$